NEWSLETTER

PRIVATE CIRCULATION VOLUME 12 NUMBER 2 SPRING 1974

AUSTRALIAN SOCIETY FOR LIMNOLOGY

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CONTENTS

3 SOCIETY ACTIVITIES

4 CONFERENCE REPORTS

4 Water sampling and analysis techniques (B.T. Hart)

6 Mosquito control (R.B. Humphries)

7 Societas Internationalis Limnologiae (W.D. Williams)

9 ARTICLES

9 Australia's bottomless lakes (B.V. Timms)

12 Key to genera of Australian Tanypodinae larvae (J. Martin)

14 Key to frogs and tadpoles of the ACT (R.B. Humphries)

18 PROFILE (George Ganf)

20 LIMNOLORE

24 RESEARCH NOTES

26 BOOK REVIEW

Bayly and Williams: Inland waters and their ecology

(B.V. Timms and K.F. Walker)

30 NEW AND FORTHCOMING PUBLICATIONS

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THE AUSTRALIAN SOCIETY FOR LIMNOLOGY

The Australian Society for Limnology is an association of over 200 people with professional or amateur interests relating to Australian inland waters. Since its inception in 1961, the Society has played an important role in fostering limnological work in this country. The ASL also promotes liaison between limnologists in academic, private, and governmental institutions, and has a vested interest in the conservation of aquatic and related resources. Annual congresses are held near centres of limnological interest, and the program includes scientific sessions, field excursions, and social activities.

The ASL publishes a Bulletin, containing scientific articles, a Newsletter, containing notes on society activities, articles of general interest, book reviews, and congress announcements. A further periodical publication is the Directory of Australian limnologists. Special publications are issued as material becomes available.

Membership applications are welcomed; four classes of subscribing membership are catered for:

- Ordinary Members ($6 pa)
- Student Members ($3 pa)
- Sustaining Members ($50 pa or more)
- Affiliated Bodies (fixed annually)

Subscriptions cover the period 1 July - 30 June.

Details are available from:

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Newsletter contributions are always welcome, and correspondence should be addressed to the Newsletter Editor. The next copy deadline is 25 November 1974.

XIV CONGRESS, CANBERRA 1975

Plans for the next congress are now being considered in detail, and an Executive Committee meeting during November will finalize them. The summer issue of the Newsletter will carry details, and will include a formal call for abstracts and preliminary registration. The deadline for both will be 1 February 1975, so please give some thought now as to whether you will present a paper or not. You would have an option of speaking for 10, 20, or 30 min, although if a large number of papers are submitted it may be necessary to impose smaller time limits. Be sure to keep the weekend of 9-12 May 1975 free for the Congress! In the meantime, if you would like to contact the organizers, write to

Mr Warren Nicholls
Dept Environment & Conservation
P O Box 1937
Canberra City, ACT 2601

Incidentally, group travel arrangements will not be made by the organizers in Canberra; this is left to the initiative of members in particular areas.

ARE YOUR SUBS, DUE?

Members are reminded that the last issue included a request to forward annual subscriptions together with relevant information for the new edition of the Directory of Australian limnologists. If you haven't done so, please attend to these matters?

LETTERHEAD

You might remember that Joan Powling volunteered not long ago to design a letterhead for the ASL. Following Don McMichael's suggestion that the lungfish Neoceratodus be adopted as the ASL emblem, Joan has drafted various combinations of lettering and the emblem, but has found it difficult to achieve a balanced design. A variation on the Neoceratodus emblem is to combine it with the Micrasterias, but at present things are still at an experimental stage. If you have any comments, or ideas for letterhead designs, drop Joan a line at State Rivers & Water Supply Commission, 90 Orrong Rd., Armadale, Victoria 3143.

BULLETIN

A new volume of the ASL Bulletin is now ready for the press. The future of the Bulletin, incidentally, has been a matter of informal debate among members of the Executive lately. The question will probably be raised at the Committee meeting scheduledfor November.

SYMPOSIUM ON WATER SAMPLING AND ANALYSIS TECHNIQUES

[This meeting was co-sponsored by the Australian Water Resources Council (AWRC), the Australian Water and Wastewater Association (AWWA), and the Royal Australian Chemical Institute (RACI), and was held in Canberra during August. The following report was prepared for the Newsletter by Barry Hart, Caulfield Institute of Technology, V.]

This symposium follows a programme of research on water sampling and analysis techniques undertaken by the AWRC, with a view to closing gaps in knowledge, and in particular, adapting known techniques to Australian conditions.

The programme commenced in 1971 with a survey undertaken by Mr. B.J. Lyons of Melbourne Water Science Institute Ltd., and covered monitoring programmes, sampling procedures, characteristics measured, analytical methods and equipment. The findings of the survey were published in AWRC Technical Paper No. 4, Water Quality Assessment Practice in Australia.

The second stage of the programme, AWRC Research Project 71/35, Improvement of Water Sampling and Analysis Techniques, was commenced early in 1973, under the direction of the project officer, Mr. J.A. McGlynn of the N.S.W. Department of Mines. This project required a series of research tasks and review papers to be undertaken by the project officer and chemists working in water laboratories. It is expected that the project will be published later in 1974.

The Symposium was to be held on the 12th and 13th August, 1974, but was altered to the 13th and 14th August, due to problems with an airline strike. Despite the travel problems, the Symposium was attended by almost 90 participants from a range of government and private organisations, universities and C.A.Es. The programme consisted of 15 'mini' papers (15 minutes delivery, 10 minutes discussion), together with two longer papers.

The Conference commenced with one of the longer papers by Professor M.A. Shapiro, Director, Westernport Bay Environmental Study and Dr. D.W. Connell, also of Westernport Bay Environmental Study. This paper, delivered by Professor Shapiro, dealt in a general way with many of the aspects of chemical sampling. Professor Shapiro stressed the need for adequate preplanning in any survey to establish the optimum location of sampling points and sampling frequency, such that fluctuations in quality can be adequately characterised.

Following this paper were four 'mini' papers devoted to the subject of sampling. Mr. T. Robb, Engineering and Water Supply Department, S.A., delivered a paper entitled 'Review of Sampling Techniques', in which he discussed the types of water sampling apparatus available. Comments were made relating to the ability of each type to satisfy a set of ideal requirements. Mr. D. Bowditch, Amdel, S.A., in his paper entitled 'Sampling -

Suitability of Containers', discussed some preliminary results obtained by AMDEL on the suitability of a range of plastic and glass containers for orthophosphate, nitrate, nitrite, ammonia, fluoride, silica, and heavy metals analysis. These preliminary results lacked adequate statistical treatment, and were rather difficult to interpret with any certainty. 'Preservation of Traces of Heavy Metals in Water Samples' was the title of the next paper, delivered by Mr. G. Ayling, Tasmanian Department of the Environment. Preliminary data was given on the effectiveness of acidification in prevention of adsorption of heavy metals onto suspended particles in seawater. The last paper in this segment was given by Miss Lucy Alford, from the Melbourne and Metropolitan Board of Works; her subject was 'The Human Element in Sampling'. Miss Alford commented on the desirable characteristics of a sampler, the training and supervision necessary, and methods for increasing work satisfaction.

Following lunch, the afternoon programme was basically devoted to a discussion of methods.

The first two papers were by Dr. R. Cottrell, La Trobe University, and Mr. T. Florence, Australian Atomic Energy Commission, who presented papers on 'Ion Selective Electrodes' respectively. 'The Role of Automation in the Laboratory' was next discussed by Dr. M. Hussain, EPA, Victoria. Dr. Hussain spent some time discussing automated titrimetric analysis and autoanalysers as used in water analysis. A general review of criteria that should be used when 'Assessing New Methods for Chemical Analysis' was presented by Dr. B.T. Hart, Caulfield Institute of Technology.

'Pitfalls of Automatic Monitoring and Equipment Purchase' was the title of the paper given by Mr. N.D. Wallace of the Water Quality Council of Queensland. Mr. Wallace discussed some of the features of monitoring systems currently available, and related problems experienced by the Department of Local Government with their automatic monitoring equipment. The last paper of the day was given by Mr. L. Bowen, Metropolitan Water Sewage and Drainage Board, Sydney. His paper was entitled 'Automatic Samplers'; and he discussed the place of automatic samples in sample networks, apparatus currently available and gave valuable advice on the Sydney Water Board's experience with automatic samplers.

The second day's proceedings commenced with a paper by Mr. N. Pilkington, CSIRO, Division of Chemical Technology, Melbourne, on 'TOC vs BOD and Oxygen Consumed'. Currently, there is interest in more rapid methods than BOD for determination of the concentration of organic matter in water. Mr. Pilkington discussed two such rapid methods, namely, total organic carbon (TOC) and total oxygen demand (TOD). Following this discussion was a paper on 'Dissolved Oxygen Analysis', presented by Mr. R. Bannister of the Victorian Water Commission. A thorough review of the methodology and interferences in dissolved oxygen measurement using, particularly, membrane electrodes was given.

The next paper, on 'Fundamentals of Aquatic Bioassays', given by Dr. David Negilski, Fisheries and Wildlife, Victoria, created great interest in this conference predominantly attended by water chemists. Biological assays (or bioassays) are one of the most important methods for determining pollutant concentrations that will not harm aquatic life. There are few laboratories in Australia with expertise in this field; however, it appears that in the near future there will be increasing use of the technique. Dr. Negilski adequately introduced the types, procedures and pitfalls in aquatic bioassays to those present.

Analytical quality control was the theme of the three mini papers given after lunch. The first paper, presented by Mr. D. Robbins, N.S.W. Health Commission, related 'Experiences with the Services of the US Analytical Quality Control Laboratory'. Mr. Robbins discussed, in particular, the reference sample service available from the Analytical Quality Control Laboratory. Australian laboratories can now obtain these samples by contacting Australian Government Analyst, Phillip, Canberra. The two other papers in this section were 'Internal Laboratory Control', presented by Mr. J. McGlynn, Department of Mines, N.S.W., and 'The Role of the National Association of Testing Authorities', by Mr. A. Russell, of NATA.

Discussions stimulated by all papers were lively and informative. It was agreed by all participants that the Symposium was a success, in its aim to bring water chemists together to discuss the important topics relating to water sampling and analysis.

It has been suggested that the AWRC organise a similarly structured symposium for aquatic biologists, to be held late in 1975.

MOSQUITO CONTROL SEMINAR

(Bob Humphries (Environ Biol, ANU) recently attended a one-day seminar on salt-marsh mosquito control, held in Brisbane on 18 September. The meeting was jointly organized by Cyanamid Australia P/L and the Brisbane City Council.)

The seminar was attended mainly by health inspectors, chemical company marketing personnel, and several professional entomologists. Its purpose was to promote and demonstrate Abate (0,0,0',0' - tetramethyl 0,0' - thiodi-p-phenylene phosphorothioate), a Cyanamid organophosphorus mosquito larvicide.

Marshland mosquitoes cause severe nuisance and some public health problems in several areas of Australia, and control has proven difficult due to expense and the inaccessibility and size of breeding areas. Toxicity to non-target organisms and bioaccumulation of pesticide residues have also caused concern.

North American research suggests that Abate is highly toxic to aquatic dipteran larvae, but of low toxicity to many other aquatic animals. Further, microbial degradation occurs in about 48 hr under field conditions, apparently with innocuous end-products. The larvicide may be applied as liquid, or in sand granules which penetrate vegetation cover and minimize drift problems. Seminar participants saw a demonstration application by a Grumman 'Agcat' 300 aircraft, and later heard talks by Harry Standfast on the philosophy and strategy of marshland mosquito control, and Elizabeth Marks on the life history of Aedes vigilax, the major problem species in northern coastal areas from Perth to Sydney.

Field trials of Abate have been carried out near Southport. For information see: Kay, B.H., K.J. Ferguson, and R.N.C. Morgan (1973), Control of salt-marsh mosquitoes with Abate insecticide at Coombabah Lakes, Queensland, Australia - Mosquito News 33, 529-535.

SOCIETAS INTERNATIONALIS LIMNOLOGIAE XIX CONGRESS

SIL recently held its XIX triennial congress at Winnipeg, Canada. The meeting ran from 22-29 August, and there were field excursions both before and after. This report is compiled from some notes kindly sent by Bill Williams, now on sabbattical in the UK. Bill is the Australian National Representative to SIL.

The congress was officially opened by Manitoba's lieutenant governor, when he poured himself a glass of water and took a drink. This, he said, was the most appropriate thing he could do as an opening gesture at a meeting of scientists dedicated to the study of freshwater! More than a thousand limnologists from more than 35 countries were present at what was evidently the largest single scientific gathering ever held in Winnipeg. A particular attraction of Winnipeg, of course, is the world-renowned Freshwater Institute.

The congress attracted a good deal of attention from local media. It must have been an impressive turn-out for a science that has not, as yet, a well-developed public image. In pointing out the relative youth of limnology, the University of Manitoba Bulletin mentioned an interesting observation by one speaker, who compared the present level of limnological knowledge* as equivalent to the level of medical knowledge in the 17th century.

An opening address of welcome was given by Dr Jack Vallentyne of the Freshwater Institute and, as it later turned out, Dr Vallentyne was elected the next president of SIL, succeeding Prof Dr Wilhelm Rodhe of Sweden. Prof Robert Wetzel, incidentally, continues as General Secretary-Treasurer. Other welcoming addresses were delivered by local dignitaries. Premier Ed Schreyer spoke on the general topic of Energy and the Environment.

The Baldi Memorial Lecture this year was delivered by Prof. H.B.N. Hynes (University of Waterloo, Ontario), on the subject 'The stream and its valley'. Bill says this went over very well indeed. Next year's Baldi Lecture will be given by Dr P. Jonasson of Denmark.

The Einar Naumann/August Thienemann Medal this year was awarded to Prof Dr Rodhe.

It's very difficult to select highlights from among nearly 500 papers that were presented, but as an indication of the scope of the meeting, consider: seasonal changes of primary production and biomass; algal ecology; tropical and subtropical phytoplankton; production methodology; culture, ecology, and physiology of microorganisms; pollution by heat, heavy metals, oil, and radionuclides; eutrophication and lake restoration; chemical budgets and chemical cycling; sediments and sediment chemistry; water chemistry; phosphorus; algal and bacterial assays; community studies; periphyton; modelling; macrophytes; zooplankton ecology; reservoirs; fish physiology, population ecology, and feeding; benthic invertebrate ecology; physical limnology; meromixis, and paleolimnology.

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* See New and Forthcoming Publications.

Each of these topics, and others, occupied morning or afternoon sessions during the meeting. Proceedings of the congress will be published in the forthcoming Verhandlungen, but in the meantime Keith Walker has a copy of the program if anyone would like to see it.

Bill says the congress was superbly organized and run by the Canadian hosts, and that it would be very difficult, if not impossible, to repeat the performance. Some general highlights:

The Baldi Lecture in itself was a highlight, and made more so by the T-shirts emblazoned with 'The stream and its valley' and a picture of Noel Hynes, worn by his students at the barbecue! A Viking/Indian review put on by the barbecue hosts was hilarious - the 'Vikings' had their moment of glory on stage singing raucous songs and reciting poetic tributes to themselves, and also had to contend with a band of marauding 'Indians'. All this set the stage for the scientific papers to follow. During the meeting a large number of bars were available for impromptu meetings between members. Later on a grand banquet was held with a concert following - splendid music, grand food, and even the Canadian wine was good!

The Freshwater Institute and the Experimental Lakes Area Field Station are magnificently equipped and situated. At this stage Bill ran out of superlatives! Evidently resources in Australia are very poor by comparison.

Five Australians were present! Ian Campbell mustered support from 'Industry', Peter Ebsworth was able to attend as he is doing a Ph.D. at Santa Barbara (California), Richard Marchant paid his own way, Alan Weatherley was funded by Norwegian sources, and Bill also paid his own way from England (where he's on sabattical). Says Bill: 'Please note the tremendous Australian Government support - particularly when you know that about eight New Zealanders attended, most of whom were directly or indirectly financed by the NZ Government.'

Two general resolutions were unanimously passed by the General Assembly of SIL. One of these related to the increasingly critical influence of acid rain in altering aquatic (and terrestrial) ecosystems. This resolution, proposed by Prof Gene Likens (Cornell University, N.Y.), called upon governments for urgent remedial action.

The second resolution, proposed by Dr David Schindler (Freshwater Institute), read as follows:

> 'Because of the critical role of phosphorus in the rapid eutrophication of inland waters, be it resolved that in addition to secondary treatment of sewage it is necessary to control additions of this element to any inland water. This should be done by any means available, including:
> - restrictions on the use of cleaning products that contain phosphates or other potentially harmful substances;
> - removal of phosphate at sewage treatment plants discharging effluents into such waters;
> - control of drainage from feedlots, agricultural areas, septic tanks, and other diffuse sources of phosphorus.
>
> Control measures for nitrogen should be considered as well in basins where there is evidence that such controls are appropriate.'

The XX Congress will be in Copenhagen, Denmark, in 1977, and then in Japan in 1980.

AUSTRALIA'S BOTTOMLESS LAKES

by Brian Timms

Avondale College, Cooranbong, NSW.

[After many years of intensive research, most recently concerned with the benthos of bottomless lakes, Brian has put together a review of this interesting class of lakes. There would appear to be a good case for admitting the type to Hutchinson's (1957) classification, under the subhead (ibid., p. 162) 'Lake basins formed by wind'.]

Mainland Australia is a land of relatively few lakes, but barmen, local yokels, tourist authorities and even the printed page would have you believe that there is an incredible number of bottomless lakes and innumerable extremely deep ones.

Take, for instance, Blue Lake at Mt. Gambier. The current tourist brochure claims it is well over 600 feet deep, and any local expert knows it is 'well-nigh bottomless' (whatever that means) and that is is connected via underground channels to a cave on the coast, for how else could you explain the aboriginal legend that a native murdered his lubra, threw her into Blue Lake, only to find her body out at Port Macdonald on the coast. (Various versions of this tale are claimed for most deep lakes - I've heard it applied to Lakes Purrumbete, Coragulac and Eacham.) Now anyone who has read the literature knows that Tamuly of Flinders University mapped the lake in 1969 and recorded a maximum depth of 77 m, i.e. 254 feet. Perhaps the locals and the Tourist Bureau can be excused for overlooking this work, just as a report by Brown in 1884 saying it was no deeper than 250 feet was missed, but how people can continually ignore a sign erected by the local council proclaiming it is 266 feet deep I cannot understand. Perhaps they reason that councils are not to be trusted, or scientists are shallow thinkers, or, most likely, they prefer to have their lake very deep; it's more mysterious that way.

As far as I know Blue Lake is the only 'bottomless lake' in South Australia, though locals claim valley Lake and Lakes Edward and Leake are very deep. For instance a skier told me 'Lake Leake, unlike Blue Lake, does have a bottom, but it is a long way down, perhaps 150 feet or more.' I found it to be only 4 m (13 feet) from the water surface! Edward proved to be only 7 m and Valley Lake 16 m deep.

Across the border in Victoria there are many bottomless lakes, and of all wonders, a missing lake. Lake Surprise, near Hamilton, occupies a steep-sided crater, a perfect prop for believing it is bottomless. Rumour has it that an ex-Monash limno was so indoctrinated by the local swillers that when he later found he could touch bottom and breathe air contemporaneously, he

reasoned he must be standing on a plate of photosynthetic bacteria. Eventually the southern part of the lake proved to be deeper but certainly not bottomless. (Max. depth = 13 m.)

Lakes Purrumbete, Bullenmerri and Gnotuk, near Camperdown are all supposed to be bottomless. Certainly it is not difficult to find a fisherman who ardently believes this. The local tourist brochure is a little more realistic (but inaccurate) in saying that Bullenmerri is 270 feet deep. By the way it also claims Bullenmerri is fresh and Gnotuk is $4\frac{1}{2}$ times saltier than the sea! Actual figures during 1969-72 were 8 and 56 ppt respectively. To return to our deep discussion, it is pertinent to note that the scientific literature is also fallacious. Claims for each lake range from 150-237 feet for Purrumbete, 150-303 feet for Bullenmerri and 45-103 feet for Gnotuk. Thorough surveying in 1971 showed the lakes to be 45 m (149 feet), 66 m (218 feet) and 18 m (60 feet) respectively.

Lake Coragulac is a bottomless lake close to Monash's Red Rock Field Station near Colac. There is the story of pioneer days, apparently true, of a horse and cart load of potatoes disappearing into the lake never to be seen again. Not unexpectedly locals claim the murdered lubra legend for the lake. Consequently everybody was surprised when Ted Hammer (on sabbatical leave at Monash 1970-71) discovered the lake was no deeper than an oar's length. I guess Coragulac must be the shallowest bottomless lake in Australia.

Rather than claim Lake Elusive in East Gippsland is bottomless, it has been said that it is so shallow as to be a mirage. Many searchers, including one limno I know, found the lake to be missing. It is little wonder, for although 22 ha in area and 22 m deep it is tucked away in a deep valley beyond almost impregnable scrub.

I know of no claims for bottomless lakes in New South Wales. Either New South Welshmen are modest folk, do not lie, or are ignorant of their lakes. I think the latter is true for few seem to have heard of Lake Hiawatha, a really beautiful lake near Grafton, or of Blue Lake up Mt. Kosciusko way. There is no argument with the fact that Blue Lake is 27 m and Hiawatha 11 m deep. However a different form of mystery shrouds Hiawatha. Those fishermen who are in the know claim there is a vortex in the middle and that this will suck man and boat to the bottom. They give credence to their belief by avoiding the lake and by arguing that since the inflow exceeds the outflow, how else can water escape? The facts are that there is underground seepage to springs along the beach and that the lake lacks commercial fish. As expected I have not been able to find the vortex, but to be fair I have not looked very hard, despite anchoring in the middle many times.

Until I ventured to North Queensland this winter, Queensland had good cause to claim the deepest lakes in mainland Australia. Popular writings maintain that Lake Eacham is either 480 feet deep or bottomless and Lake Barrine is 360 feet deep. My thorough investigation using an echo sounder and line depthing shows Eacham to be 217 and Barrine 215 feet deep. The announcements of these depths to the locals met with incredulous disbelief and, in one case, a decidedly unfriendly attitude. In discussion (i.e. arguments), I was told that a diver had been to 220 feet where he saw that the bottom was still shelving steeply; on questioning I learnt that he did not have a light, so that extinguished that proof. Another had used a rope 300 feet long and it had not touched bottom, but the day was windy, so his proof does not stand true. One man suggested that my transects had missed the deep holes, an argument that I could not find (loop)holes in. Then there

was the kind gentleman who said that the lake had filled in since they were originally depthed. If this is the case then the ace tourist attractions of the Tablelands have a miry future.

As a result of a little probing I learnt that the present accepted depths originated during the war when some Yankie servicemen (from Texas?) used a marine echo sounder on the lakes. Lack of calibration for freshwater conditions plus an unknown factor associated with the behaviour of servicemen on leave would go a long way in explaining the discrepancies between their depths and mine.

Deep down the locals must have taken some notice of my claims. Lake depths were the main subject of conversation for days and it culminated in a call being made for an independent accurate survey. I had better move quickly and publish my maps, for someone else is going to duplicate my data soon.

Finally in this report to the nation, I intend to examine the possibility of the locally believed depths of lakes being related to the real depths in some way. Consider the following data:-

Lake	A Greatest believable maximum depth (in feet)	B Actual maximum depth (in feet)
Blue	650	254
Valley	73	53
Leake	30	13
Surprise	150	43
Purrumbete	237	149
Bullenmerri	303	218
Gnotuk	103	60
Eacham	480	217
Barrine	360	215

[Obviously $B = 0.5A \pm 0.22A$ or $\pm 0.11A$]

Although the above equation accounts for all known cases it is difficult to know whether to add or substract 0.11A or 0.22A. If only I could solve these problems, no longer would I need to endure lake sickness, being half drowned, frozen stiff or cranky outboards in the pursuit of knowledge. Pleasant discussion with tourist bureaux, fishermen and locals and the application of an empirical formula would soon have Australia's lakes fathomed.

If your reaction to this tomfoolery is 'aw, go jump in the lake, mate', then I'm not scared for our lakes do have bottoms and besides my figurative legs have been sufficiently pulled to wade safely beyond the littoral.

KEY TO THE GENERA OF AUSTRALIAN TANYPODINAE LARVAE (DIPTERA : CHIRONOMIDAE)

by Jon Martin
Genetics Department
University of Melbourne

At present there are no published keys to larvae of the Australian Chironomidae. Overseas keys are useful to some extent but fall down when the endemic genera are encountered. Judging from the number of enquiries I am receiving for identifications, there is a fair demand for such keys. I am slowly producing keys but it will be some time before publication. In the meantime it may be helpful to make available those I have. The first such key is that for the Subfamily Tanypodinae. Larvae may be keyed to Subfamily using a key such as that on page 213 of Williams (1968). In order to assist in use of the key a drawing of a head capsule showing the various structures is shown in Fig. 1. Clinotanypus and Coelotanypus are based on overseas material.

1. Larvae with slender abdominal segments, no hair fringe; no paralabial comb; anal gills slender 2

   Larvae with broad segments, hair fringe present (except in Coelotanypus where there are only a few long bristles); paralabial comb or free chitin points in labrium; anal gills short 3

2. Posterior prolegs with a pair of conspicuous pectinate crotchets; lingua with 5 teeth, at least in P. levidinsis, all of equal length. Only one basal segment on maxillary palp..... Pentaneura

   Posterior prolegs with a pair of darker and stouter crotchets; lingua with 5 teeth, at least in A. notabilis, with median teeth shorter, intermediates may be curved out. Two basal segments on maxillary palp ..... Ablabesmyia

3. Antennae at least half as long as head; no paralabial comb 4

   Antennae only one third as long as head; paralabial combs present ..6

4. Antennae about three quarters as long as head; lingua with 6 teeth; free chitin points in labrium ..... Clinotanypus

   Antennae about half as long as head; free chitin points or 'paralabial' combs present; lingua with 5, 6 or 7 teeth 5

5. No continuous hair fringe (only a few long bristles); free chitin points; lingua with 7 teeth ..... Coelotanypus

   Continuous hair fringe, paralabial comb in form of almost semicircular plate with teeth around anterior edge; lingua with 5 (or 6) teeth ..... Coelopynia

Fig. 1 Diagrammatic ventral view of Procladius head capsule.

6. Superlinguae simple with 2 teeth; lingua with 5 teeth, intermediates curved outwards .....Macropelopia (=Anatopynia)

Superlinguae scale-like with serrated edge; lingua with 5 teeth, intermediates not curved ..... Procladius

Two things should be noted: Firstly, the genera Clinotanypus and Coelotanypus are based on descriptions of European species and it remains to be proved that Australian material will fit this key. Secondly, the 'genus' Pentaneura in the sense of Freeman (1961) is actually a composite group of genera. Presently I only know the immatures of one species (P. levidensis) and I cannot be certain how the others will fit this key. If anyone comes across any material which bears on either of these problems I would be interested in seeing it.

References:

Freeman, P. (1961): The Chironomidae (Diptera) of Australia. Aust. J. Zool. 9: 611-737.

Williams, W.D. (1968): Australian freshwater life. The invertebrates of Australian inland waters. Sun Books, Melbourne. 262 pp.

KEY TO THE FROGS AND TADPOLES OF THE AUSTRALIAN CAPITAL TERRITORY

by Bob Humphries

Environmental Biology, RSBS, Australian National University

(Bob is a Ph.D. student investigating the role of tadpoles in nutrient cycling in a pond environment. In the past limnologists have often neglected the amphibian constituents of aquatic communities, leaving them for the consideration of herpetologists. There is no question, however, that frogs and particularly tadpoles are integral parts of such communities, and so deserve far more attention from us than they have received in the past. The compilation of keys is a valuable step in this direction.)

Sixteen species of frogs belonging to two families have been recorded from the ACT, although some records are doubtful. The following are working keys to the adults and, where possible, to the tadpoles of these species. I hope they will enable ready identification of species, and also perhaps stimulate further work to expand our biological knowledge of these interesting animals.

The keys are compiled largely from the papers of Littlejohn (1963), Martin (1965), Martin et al. (1966), and Moore (1961), but do incorporate recent taxonomic modifications introduced by others. The key to adult frogs is designed for use with living specimens, and without magnification. At present, preserved material is required for the unequivocal identification of tadpoles.

KEY TO FROGS

1. Toes and fingers with terminal pads or discs (family Hylidae).2

   Toes and fingers without discs (family Leptodactylidae).....7

2. (1) Large, green and golden frogs with pronounced, pale, dorsolateral fold, snout long 3

   No dorsolateral fold, colour generally grey to brown, snout short 4

3. (2) Back with warts, pale middorsal stripe. Finger and toe pads reduced, web extending almost to tip of toes. Posterior surface of thighs blue with pale spots ... *Litoria raniformis*

   Back smooth, no pale middorsal stripe. Finger and toe pads prominant, web extending only half way along toes. Posterior surface of thighs blue, without spots ..... *Litoria aurea*

4. (2) Posterior surface of thighs with black and yellow vermiculations, dorsal colour grey to brown with minute green flecks. Large discs on fingers and toes. Pupil cross-shaped when contracted .. Litoria peroni

Without the above combination of characters 5

5. (4) Posterior surface of thighs purplish-brown with white spots. Dorsum light brown to yellowish, sometimes with irregular spots or mottling ..... Litoria leseuri

Posterior surface of thighs yellowish to orange, without spots. Dorsum variable in colour, from brown to greenish, with darker intact or divided middorsal patch 6

6. (5) Finger discs wider than fingers, flanks pale to bright orange. Middorsal patch usually undivided ..... Litoria ewingi

Finger discs only as wide as fingers, flanks yellow with black markings. Middorsal patch usually divided, particularly between eyes ..... Litoria verreauxi

7. (1) Vomerine teeth present 8

Vomerine teeth absent 11

8. (7) Prominant metatarsal tubercle present 9

No metatarsal tubercle, or much reduced 10

9. (8) Metatarsal tubercle fleshy, oval gland on leg. No webbing on toes, pupil horizontal .... Limnodynastes dumerili dumerili

Metatarsal tubercle black, sharp and horny, no gland on leg. Well-developed web on toes, extending nearly to tips. Pupil vertical ..... Neobatrachus pictus

10. (8) Dorsal pattern of conspicuous brown and yellowish longitudinal stripes. Metacarpal of first finger longer than second ..... Limnodynastes peroni

Dorsal pattern of brown to olive-green spots. Red or yellowish middorsal stripe present in some individuals. Metacarpal of first finger approximately equal to second ..... Limnodynastes tasmaniensis

11. (7) Parotid gland present. Orange or yellow spots on anterior and posterior surfaces of thigh .... Uperoleia rugosa

Parotid glands absent 12

12. (11) Belly granular; with leg fully extended, base of toes reaches tip of snout 13

Belly smooth; with leg fully extended, tips of toes reach snout 14

13. (12) Belly boldly blotched with black and white. Throat very dark in males, white in females ..... Ranidella signifera

Belly mostly white or greyish-white, sometimes with minute darker grey flecks. Throat dark in males, white in females .....Ranidella parinsignifera

14 (12) Dorsal surface with boldly contrasting black and yellow longitudinal stripes .....Pseudophryne corroboree

Dorsal surface grey to dark brown 15

15 (14) Dorsal surface dark, bright yellow patch on upper arm, and another in region of cloaca ...Pseudophryne dendyi*

Dorsal surface relatively pale, dull yellow or white patch on upper arm. Cloacal patch usually restricted to a thin line .....Pseudophryne bibroni*

(* There seems some doubt as to whether these taxa are specifically distinct. Morphology of both species is very variable, and tends to intergrade.)

KEY TO THE TADPOLES

1. Anus dextral. Two rows of teeth in upper labium 2

Anus median. Three to six rows of teeth in upper labium (Cycloraninae, family Leptodactylidae) 8

2. (1) Labial papillae continuous around back and sides of mouth disc. Tail tip acute (family Hylidae) 3

Labial papillae absent from posterior part of mouth disc. Tail tip rounded (Myobatrachinae, family Leptodactylidae) 6

3. (2) Mouth disc modified to form sucker. Body elongate, flattened. Tail thick, muscular with low fins, and mottled with pigment blotches .. Litoria leseuri

Mouth disc not modified to form sucker 4

4. (3) Intestinal mass without heavy melanisation. Large tadpoles (up to 100 mm). Papillary border not extended into 'wings' laterally ..... Litoria raniformis and Lit. aurea

Intestinal mass partly or completely covered by heavily melanised tissue 5

5. (4) Intestinal mass completely melanised. Nares dark-edged. Dorsal markings rather indistinct ..... Litoria verreauxi and Lit. ewingi

Intestinal mass only melanised on front third. Nares without dark edge. Dorsal markings dark, obvious. Beak very robust, deep. ..... Litoria peroni

6. (2) Papillary border apparently continuous with plates bearing both upper and lower tooth rows. Dorsal colour uniform, tail coarsely reticulated ... Uperoleia rugosa

Papillary border apparently separate from plates bearing upper and lower tooth rows 7

7. (6) Dorsal colour mottled light brown. Dorsal fin with finely reticulated pigment pattern. Body plump. ..... Ranidella spp.

Dorsal colour uniformly dark brown to black. Dorsal fin coarsely mottled or with isolated dark pigment patches. Body narrow. ..... Pseudophryne spp.

8. (1) Three rows of teeth in each labium. Jaws robust. Body globose, fin blunt, relatively short ..... Neobatrachus pictus

At least four rows of teeth in upper labium. Three tooth rows in lower labium 9

9. (8) Mouth disc oval in outline. Labial papillae in two to three rows. Fins clear, little ventral pigmentation ..... Limnodynastes tasmaniensis

Mouth disc squarish in outline. Labial papillae mostly in a single row 10

10. (9) Four rows of teeth in upper labium (occasionally a small remnant fifth row). Body usually dark brown fins dusky and/or sparsely spotted. Limnodynastes peroni

Five rows of teeth in upper labium. Body usually very dark (often black), fins heavily blotched ..... Limnodynastes dumerili dumerili

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DR GEORGE GANF is a welcome new-comer to Australian limnology, having recently taken up a post as Lecturer in Botany at the University of Adelaide. George completed a B.Sc (Hons., Botany & Zoology) at Durham University (UK) in 1966, and a Ph.D. at Lancaster University in 1969. During 1966-1973 he was a member of the Royal Society African Freshwater Biological Team, participating in the International Biological Programme, and between 1969-1973 he was the Team Leader. Prior to going to Adelaide, he was a Royal Society European Science Exchange Fellow at the University of Vienna, Austria.

George's research work has mainly concerned Lake George, Uganda. In Adelaide his plans are to look at reservoirs in South Australia with a view to eutrophication problems. His general research interests relate to phytoplankton ecology, production, photosynthesis models, the relationship between zooplankton grazing and excretion and phytoplankton nutrient supply, and water movements in relation to phytoplankton distribution.

Best wishes to George in his new appointment.

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INTERNATIONAL ASSOCIATION OF THEORETICAL AND APPLIED LIMNOLOGY (SIL)

Members of SIL receive copies of the Verhandlungen, containing papers read at the triennial congress, and the occasional issues of the Mitteilungen. (Both publications are mentioned elsewhere in this issue of the Newsletter.) If you are interested in subscribing, the rate for ordinary members (sodales) is $A4.25, and for associated groups (sodales adjunctus) is $A8.50. To receive the 1974 Verhandlungen you would need to back-date your subscription. Bill Williams is the Australian National Representative, but for the time Bill is overseas (until January 1975), local SIL affairs are being tended by Keith Walker (Environmental Biology, Australian National University, Canberra 2601), who would be happy to receive any money.

VISIT OF FRANK ROUND

Dr Frank Round (University of Bristol) recently paid a two-and-a-half month visit to Australia. Frank is currently President of the British Phycological Society, and well-known for his book 'The biology of algae' and for his studies of epipelic algae, (algae growing on mud surfaces). His Australian visit centred on the Botany Department, University of Sydney, but he made forays to the ACT, Queensland, South Australia, and Victoria. In Victoria he met with those working on the Port Phillip Bay, Westernport, and Gippsland Lakes studies, gave a talk on diatom ultrastructure one evening at the Melbourne University Botany School, and lectured on algal ecology at the Rylah Institute. On a second visit to Victoria he saw the Western District lakes and was impressed by the opportunities for work there.

Frank is gathering information and ideas for a new book on algae. A couple of interesting thoughts he raised were firstly that epipelic algae are likely to be much more effective indicators of eutrophication than phytoplankton in situations (e.g. Gippsland Lakes) where currents are highly variable, and so are deserving of much more study than they have received in the past. Secondly, he remarked on the surprizing (apparent) absence of the diatom Stephanodiscus in Australia; this is a very common constituent of eutrophic plankton communities in overseas countries. Similarly, the widely distributed blue-green alga Aphanizomenon, important in overseas environments, is not so in Australia. Is anyone able to offer enlightenment on these apparent anomalies?

HIPPO SCARE IN NSW

Bob Faragher (Fisheries Branch, NSW Chief Secretary's Department) sent the following clipping from the Sydney Morning Herald, 17 September 1974:

> "The Lake Macquarie Flora and Fauna Preservation Society, alarmed at the spread of noxious water hyacinths in Jewell's Creek, near Newcastle, wrote to South Africa recently. The society wanted to import hippopotamuses to eat the weeds. Within days the publicity forced the shire council to begin spraying the hyacinth."

MEANWHILE, AT STATE RIVERS ...

The limnology section at the SRWSC (V) has doubled with the arrival from London of Barbara Bowles. Barbara is a keen canoeist who has been enticed away from the Thames to try her skill on some of the canoeing streams of south-eastern Australia.

Prior to her departure, Barbara worked for over six years in the Limnology Laboratory of the Metropolitan Water Board, London, and had recently been appointed to a post as Assistant Biologist with the Board. Earlier in her career she worked on blue-green algae, with Prof. G.E. Fogg in the time he was at Westfield College, London.

Barbara's chief interests with MWB concerned the ecology of diatom populations in the Thames and the Thames Valley storages, the ecology and performance of the slow sand filters used in treatment of these waters, blue-green algae in the Thames storages, photomicrography, fish pathology and physiology. While at SRWSC she will be in charge of algal studies and will surely be a very valuable and welcome addition to the staff.

LOWER VOLTA PROJECT

Tomi Petr (Zoology, Monash) recently returned from Ghana where he acted in an advisory capacity to a Canadian firm of private consultants (Canadian International Development Agency) on the environmental aspects of a proposed hydroelectric scheme. A power station is to be built on the Lower Volta, 16 km downstream of the existing Akosombo storage - the largest man-made lake, in terms of area, in the world. The intention is to use the remaining 15 m of fall between the existing Volta Dam and the sea to produce an additional 100 megawatts of power, making the total output 600 megawatts.

Health aspects are of paramount importance and efforts are being made to avoid stretches of quiet water that are ideal for transmission of the human parasite Bilharzia. About 80% of the population already suffer from this insidious tropical disease.

HARPACTICOID COPEPODS

Further to the last issue, where it was mentioned that Dick Hamond (Zoology, U Melbourne) would be pleased to see any collections of harpacticoids from Australian inland waters, aspiring collectors may like to know the best way to preserve and store/transport their samples. Specimens should be picked out as cleanly as possible, and preserved in a mixture of one part full-strength formalin to 8-12 parts of water (alcohol is not an effective preservative). Tubes should be completely filled and stoppered with plastic or other inert material (but not cork). Cotton wool plugs are another 'no-no'. Detailed labels should be included, or at least labels that indicate the source of collecting data. Incidentally, Dick is not yet able to provide identifications: the taxonomic foundations for Australian harpacticoids have not yet been laid.

While on the subject of harpacticoids, some may be interested to learn that during a recent collecting foray to mound springs in central South Aust ralia, Keith Walker (RSBS, ANU) turned up what appears to be the first Australian record of the otherwise widely-distributed Nitocra lacustris. This is a species characteristic of brackish lagoons where salinity is low and variable (the SA collection was from 4.9 g/l). The mound spring collections also turned up phreatoicids (Phreatomerus latipes) and some new gastropods. More work on these springs is planned for the near future.

LETTER FROM ALAN WEATHERLEY

Recently Jim Wharton (Fisheries & Wildlife Div., V) received an interesting letter from Alan Weatherley at the University of Tromso, Norway. Here are some extracts of general interest:

"For some time it has occurred to me that you may be interested to hear a little about activities in Tromsø. You will by now have a pretty good idea of these if you have read the 'preadvertising' I sent you recently concerning three positions in the Institute of Biology and Geology. However, in addition to Professorships in Population Dynamics - Systems Modelling and Aquaculture, we also hope to advertise Professorships in Stock Assessment, Fishery Management, etc., before long. The Fjord Research Programme we are beginning is only one of several comparable programmes we expect to develop during the next couple of years. Our success will depend on the rate at which we are able to appoint staff of good calibre. Funds are not a particular problem, fortunately, as the University's development is squarely supported by the Norwegian Govt. as a prime necessity in the Socio-cultural and economic life of North Norway.

I have been learning rapidly a lot about broadscale research planning and management and about funding research programmes. Since it was to gain experience in these areas, and to develop my abilities for research strategies and learn more about modelling population and ecosystem problems that I came to Norway, I guess I can count the move as a correct one. I have had to employ quite a lot of diplomacy and patience in getting a diverse group of about 10 staff to agree to work together on the initial programme. They all 'wanted' to, but lacked the will and drive to work together. I hope they now have these - I think they do! I have found the experience very interesting and stimulating and if it is at all successful it should really enable an 'in-depth' analysis of fish populations in their trophic setting within a most fascinating and dynamic ecosystem (fjords) to be undertaken. Another very good feature of the University set-up is that social scientists, economists and food technologists are also involved in our studies. That means we are going to be training fishery people who can 'take off' professionally in any of several possible directions - thus meeting in several ways the fishery needs of North Norway. It is a challenging idea and I'm happy to be contributing to its inception. I have always had an interest in multi-disciplinary approaches in biology and here we have it for the asking.

In my own personal research I am trying to understand and ingest what is known of fjords that is relevant to our project. Surprisingly much is known of their physical oceanography (there is a flourishing school of very able physical oceanographers - Professors Gade, Saelen and Mork - at Bergen and Oslo, plus their colleagues and students), and then phytoplankton productivity (especially through the excellent studies on Oslofjord by the members of the Inst. of Limnol. & Oceanogr. at Oslo Univ., and the biologists of the museum of Univ. Trondheim, on Trondheim fjord). Understanding of the zooplankton is much less satisfactory due to the extreme dynamism of seasonal effects, and the same applies to fish. But my hope is that, if we can only digest what is known fully, we can schematise it and hopefully model some of the processes in generalized preliminary ways that will help us to orient our field and lab work and also, thereby, enable us to sharpen and make more crucial our subsequent modelling. Fishery management is our avowed final aim, but I am personally convinced that we should base our management advice and procedures on a much more complete comprehension of the entire fjord ecosystem and its trophic dynamics than has been attempted hitherto.

On a broader front I want to see the University build up an entire research and teaching capability, in fishery science, of good quality. And to this end I have written position papers for the University Administration which appear to have been well received. I have also tried to do rather more than merely indicate the positions we need by suggesting the functional links that should exist between them in relation to the entire strategy of our possible operations.

In the long-run these objectives are open-ended, but I am trying, in my thinking, to break them down into achievable modules that can, hopefully, be completed in fairly definite times."

A LIST OF TAXONOMISTS?

One useful service the Newsletter performs is to advise of the willingness of limnologists (here and overseas) with taxonomic interests to accept biological specimens for use in their studies and, in most cases, to provide identifications. These items tend to appear frequently and it may be useful if the relevant information was consolidated in one list showing

- the taxonomic group of interest
- geographic limits (e.g. SE Australia or Australia or Indo-Pacific)
- name and address of the specialist
- recommended method of preservation and storage
- whether identifications would be supplied (where possible)

If sufficient members with such interests advise the Newsletter Editor, a list could be included in a future issue. It would be over optimistic to think a fully comprehensive list might be compiled at the first attempt, but this would provide a basis for subsequent revisions - perhaps on an annual basis. Because the Newsletter will not reach everyone who might like to be listed, you might advise of other people's interests as well, should you happen to know.

BOOK NOTICES & REVIEWS IN THE NEWSLETTER

It may be possible to expand this aspect of the Newsletter if members who receive recently published books on limnological topics were to send a short report for inclusion in these pages. At present very few books are sent to us for review purposes, and it has not been possible to keep pace between the appearance of new works and reviews in the Newsletter. Reports will be classed as reviews if they contain critical comment as well as an outline of format, scope, etc., and as notices if they do not include a critical assessment. Both forms of report would be welcome.

ECOLOGICAL SURVEY OF LAKE MACQUARIE AND TUGGERAH LAKES

[Bruce Hodgson (Zoology, UNSW) is currently involved in a study of zooplankton ecology of Lake Macquarie and the Tuggerah Lakes, NSW. This study, however, is only one part of a much broader programme, which Bruce outlines below.]

The aim of these studies is to gain a better understanding of the ecology of these lakes, and to assess the effects of pollution (thermal, sewage, heavy metal, etc.) upon the biology of the lakes so that suitable guidelines can be drawn up for the development and future use of the lakes.

Studies which are in progress are: micro- and macro-zooplankton, benthic infauna, seagrass distribution and culture, hydrology (including nutrients) and heavy metal determination of water and sediments. There are some studies which have been completed, for example, fouling organisms (Bayliss, M.Sc. Thesis, U.N.S.W.). This programme involves many different departments, for example, the University of New South Wales, the University of Sydney, New South Wales State Fisheries. Several laboratory experiments are in progress, some of which involve temperature tolerance of finfish (mullet) and shellfish (mussels).

Zooplankton (taken with a 200 micron mesh net) are being sampled monthly at eight stations in Lake Macquarie and at ten stations in the Tuggerah Lakes. There are three power stations using water of these lakes for cooling purposes. Zooplankton tows are taken at the inlet and outlet of each power station, and in addition there are four more sampling stations along a transect off the Munmorah Power Station. It is hoped that by monitoring these stations, differences in population and species abundance between inlet and outlet (if any) can be correlated to the outlet water temperature of the power station. Preliminary results show that zooplankton abundance varies considerably along the transect off Munmorah Power Station, probably as a result of water movement, vertical migration to discontinuities (thermocline and/or halocline) and sinking of zooplankton killed by passing through the power station cooling water system.

Salinity and temperature measurements are taken at each of the sampling stations mentioned, and water samples are taken for dissolved oxygen, nutrients and chlorophyll *a*. Secchi depth is measured at each station using a 23 cm disc painted with black and white quadrants. Water is filtered through fibre-glass filter paper and total suspended solids determined after drying in order to relate Secchi depth with the amount of particulate matter present in the lakes.

The nutrients being determined are inorganic and total phosphate, nitrate and nitrite, and silicate. Hopefully a nutrient balance for the lakes can be calculated, knowing the amount of freshwater and seawater entering and leaving the lakes. All the major creeks are being monitored, but not as frequently as the lakes.

Nutrients can be related to oxygen utilization (regeneration by bacteria) and directly to oxygen concentration (release from sediments) and to zooplankton (direct regeneration) as well as phytoplankton standing stock (as measured by chlorophyll a).

Nutrients and chlorophyll a are good indicators of cultural eutrophication when considered together. Preliminary results show that high nutrients and chlorophyll a occur in the northern part of Lake Macquarie, probably due to sewage effluent from local sewage works.

Lake Macquarie and the Tuggerah Lakes are being subjected to a variety of stresses due to human activity. At present the human population around these lakes is not large compared to the major population centres. However, expansion is being planned for these lakes and fortunately studies such as the one described above are being carried out before development begins.

THIS SPACE IS FOR SALE

Following the practice introduced in an earlier volume, potential advertisers may be interested to know that advertisements (e.g. for scientific apparatus) are accepted for the Newsletter. The charges are $20 per page or $15 per half page, and do note that acceptance is conditional upon prepayment. Art work (such as a company emblem) is acceptable, providing it's not too complicated! Arrangements may also be made to distribute leaflets with the Newsletter, but in this case charges would be fixed on inspection.

At present printing of each issue runs to well over 300, and distribution includes a wide cross-section of the Australian limnological community, including private, public, and academic sectors. Correspondence may be addressed to the Editor, but cheques should of course be made payable to the Australian Society for Limnology.

Bayly, I.A.E. and W.D. Williams. 1973. Inland waters and their ecology. Longman Australia. 316 p. Price $15.00. ISBN 0 582 71421 4.

Reviewed by Keith Walker and Brian Timms

Bayly and Williams have done an enormous amount to foster development of limnology in this part of the world. Since the early 1960s, when they joined forces at Monash University in Victoria, they have seen Antipodean limnology grow from sporadic beginnings to a more mature discipline where knowledge is accumulating on many fronts quite outside the academic arena.

The appearance of this book, then, is a milestone. It is an overview supported by more than ten year's involvement on the part of the authors, and it will surely stimulate further development by showing those areas where future research is most needed. It is intended primarily as a teaching text for use in Australasian universities and so makes extensive use of local studies for illustration. In this role it will help occupy the void that exists between general texts that are too superficial for specialized instruction and advanced treatises too expensive to be easily accessible to all undergraduates and non-specialists. Apart from its value as a teaching aid, the book serves also as a compendium of source material, having a large and comprehensive bibliography (nearly 22 pages). Although, like virtually all text books, it is a little out of date even soon after publication, this problem has been offset by inclusion of much otherwise unpublished information drawn from colleagues and students.

The presentation is compact, but easy on the eye, and an appealing feature is a series of fine photographs, for example a magnificent aerial view of Cooper's Creek in flood, and several others of well-known lakes. Also notable are the separate indexes for lakes and reservoirs, species, and general subjects.

The preface offers a rationale for considering both Australia and New Zealand together, and makes the point that both countries are bound by historical, political, and linguistic ties, quite apart from sharing a strong biological affinity. Nonetheless, there are substantial differences between the respective limnological environments, and it may have been useful to include a chapter exploring these aspects in detail. The much-neglected subject of trans-Tasman freshwater biogeography in itself is not wholly irrelevant to the book's purpose, and perhaps would be a useful contribution towards cementing links that already exist between limnologists in the two countries.

Aside from the intended regional bias, the general approach to the subject is, for the most part, a traditional one, and it is easy to recognize the influence of standard works such as Hutchinson's A Treatise on Limnology and Hynes' The Ecology of Running Waters. The book's contents are arranged in six parts: part one surveys some general features of inland waters, parts two and three are devoted to lakes and running waters respectively, parts four and five deal respectively with other bodies of freshwater and athalassic saline waters, and part six ventures an appraisal of relationships between man and inland waters.

A general criticism is that parts one and two are unbalanced, giving undue weight to some aspects either by overemphasis or by neglect of other viewpoints. Whilst this may be excusable in terms of the disparate nature of local knowledge, or because existing accounts may be biased, it is least so in a general teaching text where the object must be to present as balanced a view as possible. We recognize, of course, that to strive for such balance is the bane of everyone compiling a text book, but the feeling remains that here the student might be advised to venture into some supplementary reading.

Chapter 1 concerns some general chemical aspects of inland waters, and briefly introduces major ionic composition, sources and mechanisms of ion supply, dissolved organic matter, pH, nitrate and phosphate, and dissolved oxygen and carbon dioxide. A disproportionately large amount of text, it seems, is devoted to the physiological significance of ionic composition, a section that might better have been incorporated elsewhere. On a 'pin-pricking' level, we note it is not made clear that the pH endpoint of 4.5 (relevant to bicarbonate measurement) is inappropriate to some waters (p. 2), and that ternary ionic diagrams are equally as useful for cations as for anions (p. 6).

In Chapter 2 ('Biological production') some might baulk slightly at the idea that the term production does not involve time. In an effort to clarify the term in an ecological context, the authors have chosen to follow popular dictionary usage and speak of production as (a) the process of producing, and (b) the quantity of material produced. Without meaning to enter into a pointless semantic controversy, it seems to at least one of the reviewers that, at least in ecological parlance, it is most convenient to interpret production as a rate concept, so that it is un-necessary to specify 'the rate of production'. To simply state the primary production of a lake as, say 100 g C/m^2, is virtually meaningless unless there is also an indication of the time interval involved; otherwise the distinction between standing crop and production is obscured. The essential point, however, is that while we might choose to consider that 'rate' is not implicit in 'production', the two are inextricably related, and it is probably a little misleading to say (p. 29) that 'concepts of rate ... are not involved in ... definitions of production and productivity'. In at least two places (Table 2.2 and p. 67), production values are cited as grams per day or grams per year.

In any case, chapter 2 is a good perspective on what undoubtedly has become a central focus of limnological research in recent years. It begins by outlining the Lindeman-Hutchinson concept of energy relationships within ecosystems, and proceeds to the notions of standing crop and production. Methods and the relative significance of different forms of primary and secondary productivity are considered in some detail, and the chapter concludes with mention of ecosystem energy budgets.

And so to lakes. Chapter 3 commences with a very interesting discussion of the different modes of origin of lake basins, in the context of an improved version of Hutchinson's classification and, of course, with selected examples from Australia and New Zealand. The basic morphometric parameters of lakes are defined, and here we might note an error in the formula given for shoreline development (p. 62), where the '2' in the denominator belongs outside the square root symbol. Terminology of the major ecological regions and biological communities is introduced at this stage.

Chapter 4 is unbalanced, but part of the reason may be that the title ('Productivity'), rather than the accompanying text, is inappropriate. Essentially, the chapter relates to some factors that are broadly correlated with lake productivity. Discussion of the influence of basin morphology is confusing, particularly that relating to Figure 4.1, and it is difficult to accept as a generalization statements like ' ... planktonic productivity is largely independent of mean depth' (p. 70). Phosphorus is dismissed far too quickly here, and disproportionate emphasis is given to carbon. Certain sections of this chapter (e.g. paragraph 1, p.76; 3, 77) place rather too much faith in the power of correlation and other statistical techniques.

Thermal stratification, meromictic lakes, optical aspects, and seiches are discussed in chapter 5, basically as purely physical phenomena, but with some attention to their chemical and biological significance. An expanded version of the Hutchinson-Löffler classification of thermal types is proposed to accommodate certain Australasian lakes that ice over in winter and have a summer holomixis at temperatures well above 4°C. The new classification does not take account of various criticisms that have been made against the Hutchinson-Löffler scheme, and so does little to resolve confusion and ambiguities that are entrenched in the limnological literature (thus ' ... Lakes Bonney and Vanda (in Antarctica) are both amictic and meromictic' (p. 87)). It would be inappropriate here to discuss this fully (cf. Walker and Likens in press), but briefly the arguments are that

- the basic scheme is unnecessarily restricted by inclusion of geographic and climatic, as well as thermal, criteria (hence confusion about the distribution of polymictic lakes)

- thermal phenomena are not always a valid guide to circulation types, yet the two are often confused (meromixis, for example, is fundamentally a circulation phenomenon rather than a thermal one)

- the significance of '4°C' has been overemphasized in limnology (for many lakes the annual transitions past 4°C have no obvious significance in terms of circulation patterns)

- terms like 'amictic' and 'oligomictic' are ambiguous (no known lake is strictly amictic, and the distinction between oligomixis and meromixis has never been clear)

Chapter 6 is devoted to the very broad subject of ecology of major lake communities, and contains an interesting discussion of species associations among calanoid copepods and an excellent review of diurnal vertical migration. In discussion of cyclomorphosis (p. 121), an interesting student project is suggested by the fact that evidently no-one since Sars in 1914 has made a complete seasonal study of morphological variations in the very common Daphnia carinata. The account of phytoplankton is largely concerned with desmid species associations and dilute waters, the applicability of Hutchinson's classification of phytoplankton associations, and with the applicability of phytoplankton indices to local waters. The treatment given benthos is necessarily generalized, but very good use is made of the meagre local data. The chapter concludes with brief comments on macrophytes, Aufwuchs, nekton, psammon, and pleuston. We note that the lack of emphasis in some important areas is a fair reflection of the intensity of relevant local studies!

Running waters are discussed in part three, chapters 7 and 8. A remarkably comprehensive review is provided, with a strong local flavour despite the paucity of relevant studies in Australia and, to a lesser extent, New Zealand. Non-biological features include physiographic background, physical features such as discharge and temperature, and chemical features (mainly salinity). Biological features include species composition, adaptations to stream life, drift, zonation concepts, and briefly the holistic aspects of stream ecosystems.

Other bodies of freshwater, such as underground waters, springs, temporary waters, and ponds, are discussed in chapter 9. Special emphasis is given to a remark (p. 184-5) that 'farm dams are ubiquituous throughout Australia and many parts of New Zealand, are generally accessible for study, and would form admirable objects for research projects at a variety of intellectual levels'. There is a lesson, however, in the reaction of the pioneer English ecologist, Charles Elton, who was repelled from a study of pond communities because he found as many different communities as ponds visited!

Chapter 10 is a fine review of the ecology of salt lakes, principally those of south-eastern Australia. These waters typically are shallow, eurythermal, poikilosaline, and homogeneous in ionic composition. Discussion of the flora and fauna is mainly in terms of habitat and salinity tolerance, but the high degree of endemicity, unusual aspects of species composition (e.g. planktonic ostracods), and the predominantly freshwater origin of the fauna are highlighted. The chapter concludes by emphasizing the value of the relative simplicity of saline lake ecosystems in ecological research.

Part six is something of an innovation for a book of this kind: it discusses applied aspects of limnology. Chapter 11 is devoted to the diverse uses of inland waters, and chapter 12 deals with the effects of man. At the rate this subject is developing, part six could easily occupy an entire new book, but the authors have done well to ensure broad coverage.

The value of this book extends far beyond the classroom; it is most highly recommended to all concerned with limnology in Australia and New Zealand, and also contains a great deal to interest overseas limnologists. An appropriate way to complete this review is to congratulate Ian and Bill on their invaluable contribution. It is salutatory to their efforts to say that we hope to see a considerably enlarged edition ten years hence!

DAMMING THE WORLD'S RIVERS

It is estimated that three-fourths of the world's land surface is potentially available for river basin development. At present 10% of the world's total stream flow is regulated by man, and by 2000 A.D. some two-thirds of the total discharge will be controlled. (Wallaceana 2)

Lake, P.S. and V.J. Thorp. The gill lamellae of the shrimp Paratya tasmaniensis (Atyidae: Crustacea). Normal ultrastructure and changes with low levels of cadmium. VIII Internat. Congr. Electron Microscopy, Canberra, 1974. Proceedings vol. II.

Thorp, V.J. and P.S. Lake. (1973) Pollution of a Tasmanian River by mine effluents. II. Distribution of macroinvertebrates. Int. Rev. ges. Hydrobiol. 58, 885-892.

Dobrotworsky, N.V. The Tipulidae (Diptera) of Australia, VIII-XI. Aust. J. Zool. Suppl. 25, 1-75.

Ratkowsky, D.A., S.J. Thrower, I.J. Eustace, and J. Olley. A numerical study of the concentration of some heavy metals in Tasmanian oysters. J. Fish. Res. Bd. Canada 31, 1165-1171.

Stevenson, J.C.(ed) Limnology in Canada - Special issue prepared for the XIX Congress, International Association of Limnology (SIL). J. Fish. Res. Bd. Canada 31, 501-1020. (As you might guess from the size of this issue, this is a thorough review of Canadian limnology; it is very highly recommended. Papers by all your old favourites!)

Scott, T.D., C.J.M. Glover, and R.V. Southcott. 1974. The marine and freshwater fishes of South Australia. (Second edition). Handbooks of the Flora and Fauna of South Australia. Govt. Printer: Adelaide. (A updated revision of Scott's earlier book, this time printed on waterproof polypropylene film. Costs $6.40 with postage. Write: Govt. Printer, Box 210, P O, Plympton, SA 5038.)

Jubilee Symposium: 50 years of limnological research. Mitt. int. Ver. Limnol. 20, 402 p. (1974) A review of problems and achievements in various fields of limnology by eleven invited lecturers at the Jubilee Symposium of SIL, held in Leningrad, 1971. A selection of the contents:

History of limnology (Elster)
SIL: creation and functions (Rodhe)
Paleolimnology (Frey)
Lake hydrodynamics (Mortimer)
Microbiology and biochemistry (Overbeck)
Secondary production (Edmondson)
Fish ecology and its application (Regier)
Fifty years' limnic zoogeography (Brundin)
Running water (Macan)
Trends in limnology (Elster)
Some problems and perspectives in applied limnology (Wuhrmann).

Hart, B.T. A compilation of Australian water quality criteria. AWRC Tech. Pap. 7, 349 p. (A most important contribution to Australian limnology, obtainable from the Australian Government Publishing Service (AGPS) for about $6.50.)

Timms, B.V. Aspects of the limnology of Lake Tali Karng, Victoria. Aust. J. mar. Freshwat. Res. 25, 273-279.

Doetsch, R.N. and T.M. Cook. (1973) Introduction to bacteria and their ecobiology. University Park Press, Baltimore, Maryland. 402 p. (Price US$12.50; catalog ISBN 0 8391 0736 6. A cohesive study of bacteria as intrinsically important living organisms, with particular emphasis upon their activities in and their interactions with their environment.)

Brinkhurst, R.O. 1974. The benthos of lakes. The Macmillan Press, London. 192 p. (Price: around A$25-30; Catalog SBN 333 17644 8).
Dr Brinkhurst is Director of the Canadian Fisheries & Marine Service Biological Station at St Andrews, New Brunswick, and is well-known for his work on aquatic Oligochaeta. The present book reviews, for the first time, the aims and achievements in research of lake bottom fauna. The contents are as follows:

Glossary

Part I The distribution and abundance of lake benthos
- Ch 1 Themes in benthic research
- Ch 2 Lake typology
- Ch 3 Bathymetric distribution
- Ch 4 Production and productivity (M.G. Johnson)
- Ch 5 Community analysis (A.V. Tyler)

Part 2 Sources of variability
- Ch 6 Spatial and temporal complexity
- Ch 7 The sampling problem

Part 3 Discussion
- Ch 8 Discussion and conclusions

Bibliography

Subject index

Systematic index

Quoting from the advance notice, the work is 'a survey of what students of lake benthos have been attempting to find out, what motivated their researches, and a synthesis of progress to date. Classical concepts are examined to enable comparison with earlier objectives. The sources of the complexity which frustrates attempts at generalisation are reviewed so that future researchers will be able to account for them and a brief review of the methodology which can be adopted in view of these difficulties is presented. The author ... attempts to show that older, technically suspect studies may contain ideas just as valid today as in the past, that slavish adoption of current trends can be as damaging as unreasonable adherence to classical approaches for their own sake ...'

Vallentyne, J.R. 1974. The algal bowl. Lakes and Man. Misc. Spec. Publ. 22, Fisheries and Marine Service, Canadian Dept of the Environment, Ottawa. 186 p.

Dr Vallentyne is well-known for his work on eutrophication, as a member of the Freshwater Institute in Winnipeg. The abstract of the book reads as follows:

'This is a book for nonspecialists about lakes and how they are affected by nutrients derived from human activities (man-made eutrophication). The nine chapters cover the following topics: (1) the biological classification of lakes and the role of phosphorus and nitrogen compounds in stimulating the growth of algae and aquatic weeds; (2) historical accounts of man-made eutrophication of the Lake of Zurich, Lake Erie, and a chain of four lakes in the vicinity of Madison, Wis.; (3) how the vertical circulation of water in lakes is regulated by the action of sun and wind; (4) interrelationships among carbon dioxide, oxygen, and organic matter in natural waters; (5) phosphorus in the biosphere; (6) methods for control of man-made eutrophication; (7) detergent phosphates in the cause and control of man-made eutrophication; (8) the 1970 controversy over nitrilotriacetate (NTA) as a replacement for sodium triphosphate in detergents; (9) a view that man-made eutrophication is better regarded as a sign of a deeper, Faustian problem than as a problem in itself. While the central theme of the book is that phosphorus is the key to the control of man-made eutrophication, an analysis of ultimate causes shows the need to control demophoric (population X technological) growth. A list of scientific terms and definitions is included, an appendix with an updating of events to 1974, suggestions for additional reading, and a sequence of tables and figures for the scientifically inclined reader.'

The price, including postage, is CAN$3.60, and copies may be obtained from

Information Canada
Ottawa, Canada K1A OS9

Joint Government Technical Committee on Mine Waste Pollution of the Molonglo River. Final report on remedial measures, June 1974. AGPS, Canberra. 68 p. Price: $2.25. (An important report that will be considered in detail in a future Newsletter).

Walker, K.F. The seasonal phytoplankton cycles of two saline lakes in central Washington. Limnol. Oceanogr.

Williams, W.D. Inland waters. Mem. Ecol. Soc. Aust. 8.

Two articles in the most recent issue of Search (vol 5 no 9) are devoted to further examination of the new Insect Export Regulations. K.H.L. Key replies to an earlier article by Talbot and Smithers, and explores the case for the legislation. E.N. Marks outlines the (mainly adverse) reactions of 40 senior foreign entomologists.

Cribb, A.B. Some freshwater algae from Fraser Island. Qd. Nat. 21, 7-11.

Environment Protection Authority. (1973) Methods for the analysis of water and wastes. EPA, Vic. (Write: EPA, 240 Victoria Pde, East Melbourne).

ERRATUM! An unfortunate error crept into last issue's lyrical report on the Noosa Congress. Joan Powling is not, of course, the ASL's first lady President - that honour certainly belongs to Dr Hilary Jolly, the President in 1968-1969. The Editor offers profound apologies!